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ABSTRACT

The 18 brief articles contained in this booklet reflect an attempt by science and math teachers in Nevada to explore ways to rekindle the exhilaration of discovery for themselves and their students that began with the knowledge explosion that followed the launching of Sputnik in 1957 but that was eventually washed away in a flood of "keep-em-busy-get-the-right answer" lessons. The Nevada teachers recognized writing as a powerful thinking activity and began to explore its uses as a way of focusing on understanding concepts instead of simply memorizing facts for tests. Each article develops at least one activity in either math or science for which students use writing as an important learning tool. Among specific topics are a unit plan on the Great Barrier Reef and lessons concerned with the weather, the concept of natural selection, dinosaurs, the human body, rocks and their properties, and the atom. The booklet includes articles on: integrating the writing process in science; writing in middle school science; writing in fourth grade; writing for different audiences in grade 5; the "write" way to learn math; writing in the high school science class; and writing for science concepts in the third grade. One paper discusses the issue of "deplagiarizing" the research paper; others offer observations on note taking, journal writing, evaluating mathematical expressions, and problem solving.

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The Science and Writing Connection

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The Nevada Science Project

This booklet is the first effort of the Nevada Science Project. It is intended that the booklet be an in-service or self-teaching manual to promote and improve the teaching of science. It brings together some of the thinking and some of the teaching ideas and units developed in conjunction with the Bob Tierney workshops funded by the Eisenhower Act held in Reno, Elko, Lake Tahoe, and Las Vegas.

The project's second activity will be a two-week summer institute (June 17-29, 1990) for 20 Nevada science teachers from kindergarten through college level. The institute will focus on some of the scientific and technological problems confronting Nevada, the nation and the world: air, water and mineral resources. The institute is being funded by a grant from the University of Nevada System under the Eisenhower Act. The project plans to have yearly summer institutes, alternating between Reno and Las Vegas, on pertinent science topics, training teachers who will in turn train other teachers in the subject matter of the institutes.



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Introduction

A wise man once said: "Writing is a powerful way to learn." Someone wiser said: "If that is true, then writing belongs in all classrooms."

The first wise man replied, "Writing can help the student to clarify ideas about any subject."

"Yes," answered the second wise man. "Writing involves discovery, synthesis, inquiry rather than regurgitation of factual material. To write clearly, students must think clearly."

"I see," said the first wise man. "When students learn to write better, they have learned to think better."

The second wise man looked concerned. "Why don't all teachers in all disciplines use writing as a tool for learning in their classrooms?"

Many of Nevada's science and mathematics teachers do integrate writing into their curriculum. Some of these teachers attended workshops conducted across the state by Bay Area Writing Project consultant Bob Tierney, a science teacher at Irvington High School, Fremont, California.



We asked these workshop participants to write us about how they use writing in their classrooms. How does writing fit into their curriculum as a whole, we asked. What are the connections between writing and learning? We also asked them to send us writing activities that they had used or planned to use in their classes.

These science and math teachers were creative in selecting the activities and honest in telling about their successes, frustrations, failures, and discoveries. Most of all, they share with you the discovery that writing can be a powerful and important facet of teaching and learning. Writing helps a student to learn and to think. From now on, teaching for them will not be the same. In so many words these Nevada teachers have told us: "From writing, all else follows." ♡

Neil Fockler
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Preface

by Bob Tierney

The launching of Sputnik I in 1957 caused an outpouring of money by the National Science Foundation and others to upgrade science instruction in the United States. Millions of dollars were spent for science teacher institutes all over the nation. The theme song of the institutes was "Do not teach science as a body of knowledge to be memorized. Teach science as a concept. Make the student hypothesize, draw conclusions. Make the student think." Programs such as the PSSC physics, CHEM STUDY, and BSCS BIOLOGY also contributed much to the background knowledge of science teachers and attempted to provide teachers with activities designed to make their students better thinkers. Studies, by Paul Hurd and others, indicate that a significant number of science teachers returned to the classroom, attempted the new techniques, but for various reasons returned to their old way of teaching, i.e., reliance upon the textbook/lecture mode.

Teachers complained: Students could not explore theory without knowing the facts first. There was never enough time to complete the inquiry type labs the new programs envisioned; curriculum guides at state and local level, reflecting the explosion of science knowledge, demanded more content be taught. Textbooks got larger as publishers tried to package science knowledge; budgets were reduced; the supply of trained science teachers dwindled as demand for them increased.

Worksheets, some of them commercial products, most of them teacher made, replaced inquiry. Students sought "correct" answers without understanding the concept. Worksheets, lectures, films, and cookbook labs became a way for many, too many, teachers to survive. The exhilaration of discovery, the very essence of science, was washed away

in a flood of "keep-'em-busy-get-the-right-answer" lessons. Students learned how to dry lab. They learned how to cheat. Numbers of students taking science classes, other than the required ones, shrunk.

The articles contained here reflect an attempt by the science and math teachers of Nevada to explore ways to rekindle the exhilaration of discovery for themselves and their students. They are taking the risk of changing the way they teach. Writing, a powerful thinking activity, has been explored as a way to focus on understanding concept instead of memorizing for the test. The teachers, along with many of their colleagues, attended weekend workshops where they shared ideas and acquainted themselves with the work of the Bay Area, Northern Nevada, and National Writing Projects. They have found the *Writing Process* is similar to the *Scientific Method*. Both are learning processes; both lead to discovery. That science and math teachers readily see writing as a tool to learn should come as no surprise. Math is the language of science. The keeping of journals, field notes, and lab write ups have been an essential part of science for centuries.

I have watched elementary teachers working as equal partners with math and science teachers at the secondary level. I have seen teachers from every corner of the state give up weekends in order to explore discovery ideas for classroom use. I see teachers making the time to think through their philosophy of education. I see teachers sharing, experimenting, publishing. We may be on the threshold of the most exciting decade in American education. Many Nevada teachers will be leading the way. It has been an honor for me to work with such a group of real professionals. ♡

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Integrating the Writing Process in Science

by Del Barber

Rancho High School
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Step back in time with me to a high school physics class being taught in the mid 1950s. The instructor is telling the students that we will put a man on the moon and bring him back to earth, that microwaves will be used for communication and cooking, and that lasers will be used to do microsurgery. Some of the students scoff, "He has really lost it!" Others say, "He believes all that science fiction stuff he has been reading!"

Well, as we all know, these events did come to pass. But it was the Russian Sputnik that put the first man in space. In recognition of our lag in science education, the United States created the National Science Foundation. They began offering summer institutes for high school science and mathematics teachers to improve overall instruction. Through the 1960s learning to teach science as a process was the "in" thing. Most of the effort in education went toward the redirection of teaching in the science and math areas with little emphasis on the liberal arts. Thus, the United States produced better scientists and mathematicians without the same improvement of quality for their writing.

It appears that these same mathematics and science teachers have failed to relate this teaching as a process to the area of scientific writing. They purport that writing is the responsibility of the English department. When content teachers do have writing assignments, they usually are mechanical—slotting information on a worksheet or copying from the textbook. This statement has

been supported in a study by Arthur Applebee (1981).

But let us not seek to blame any one discipline for low quality writers. Teachers in general are not prepared to teach writing. A cross-curriculum study by Tighe and Koziol (1982) reported that 62 percent of the English teachers, 82 percent of social studies teachers and 77 percent of the science teachers lack formal preparation for working with writing skills. Arthur Applebee (1981) reported that, when teachers do attempt to have students write, it is impromptu and the writer is confronted "cold" with a blank paper, meager instructions, and a brief time to write. The results are treated as a final draft, with evaluation treating mechanical errors and neglecting ways that will improve the product.

Armed with this kind of data, the 1980s produced another national gem, the National Writing Project. It is through this project that the teaching of writing as a process rather than a product is being developed.

As this approach permeates the curriculum, other disciplines will discover that process writing enhances their product as well as knowledge acquisition. This was reported by several authors examining the writing process in science, such as Cory (1982), House (1983), Levine (1985), Dittmer (1986), Vargus (1986), Self (1989) and Soriano (1989). Arthur Applebee (1981) concluded that "It is only when students begin to write on their own that the implications of new knowledge begin to be worked

through, and that they really know the material."

All of this data and research are quite enlightening! But what is it all about; and how do I apply it to content without increasing my work load? All right, let us examine this whole thing in stages. First, how do I do this without adversely affecting content acquisition. Second, do students learn more? Third, how often is it appropriate to use the writing process in a content classroom. And finally, what do they mean "The stages of the writing process are prewriting, writing, revising, editing and publishing?" What follows is a description of how I've dealt with each of these questions and the implementation of the writing process in science. I'll begin with the final question first.

During the prewriting stage, which I prefer to think of as the prethinking stage, it is important to focus student thinking on a scientific concept or principle. I use classroom demonstrations to facilitate this process. The demonstration focuses the student on the concept, piquing their curiosity and imagination. Following the demonstration, students are placed in response groups of four. Students work in these groups throughout the prewriting, writing and revision stages of the process. The first task of these groups is to prepare a "mind map" (Buzan 1976), or a "cluster" (Rico 1983) summarizing the demonstration. This group activity enables students to verbalize, internalize, and synthesize the demonstration while accommodating different cognitive learning styles. This activity consumes about fifteen minutes.

It is during the text stage that I attempt to "kill two birds with one stone," that is to "learn to write" and "write to learn." This is where the creative genius of the science teacher really comes through. Preplanned writing assignments encourage students to

clarify, manipulate, and apply newly gained knowledge. Using maps or clusters for a guide, students complete the writing phase.

To initiate the revising phase each student reads his/her paper to the other members of the response group. This activity allows peer interaction and assistance with the semantics and mechanics of the paper. The next step of the revising phase is the "read-a-round." During this full-class activity all student papers are circulated through each response group until every student has had a chance to read all the other students' papers. I normally allow one minute per paper, consuming about forty-five minutes of a class period. This activity gives students a chance to experience their peers' thoughts, feelings, ideas, insights, and understandings about the demonstration. Following the read-a-round, students are asked to rewrite their report, using any new information they may have acquired.

The next day students return to their response groups. Again, students share their papers with other members of the group, this time emphasizing the editing process. The final, revised, edited copy is now due for instructor evaluation. This writing process has reached completion.

The first question regarding increased workload as a result of introducing writing into content areas has been confronted. One writing assignment can replace several worksheets and give the teacher a better chance to evaluate the students' true understanding of concepts. Yet, there is only one paper to grade.

The second question regarding the quantity of student learning has also been addressed. In addition, the use of peer response groups can only be viewed as a positive motivating force to improve the quality of student work, attitude and per-

formance, as well as knowledge acquisition. A study by Slavin (1981) reported that cooperative learning groups improve social outcomes of schooling, achievement and self esteem.

To answer the third question, the content teacher doesn't have to give a writing assignment every week. I usually have one or two assignments per quarter, when I take students through the entire writing process. Further, I have found that after experiencing writing process activities, students of-

ten request its use for other assignments such as lab reports. Here again, the writing process has proven to be extremely effective. Both the clarity and quality of the reports have improved.

In closing, the reward in improved student attitude, achievement, and self esteem has merit. In fact, this has been accomplished without teacher load increase. If anything, the dreaded workload has been decreased with the infusion of the writing process into lesson planning. ☛

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A Unit Plan on the Great Barrier Reef

by *Debbi Thiel*,

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Philosophy Statement

Science is a way of thinking - a process to differentiate fact from inference. The goal of teaching science is to re instill mankind's natural curiosity - to return the individual to the "why" stage of a four-year-old. Schools must stop squelching the questions.

I believe that teaching science through writing and hands-on experiences is essential. Hands-on provides an opportunity to see and experience. Writing provides an avenue to explain and, therefore, understand.

I further believe that tests should reflect integration of knowledge into real life experiences and situations. To teach facts as rote memory only gets you through tomorrow. To teach thinking gets you through life.

Guidelines:

1. Stimulate student interest through creation of excitement.
2. Help develop curiosity about the subject.
3. Give students some ownership on the unit.

Unit Lesson Plan

Objectives:

Students will:

- ✓ Understand the diversity of life (slide show)
- ✓ Compare invertebrates to protozoans (comparison paper)

✓ Build the evolutionary progression to vertebrates (lecture and labs)

✓ Observe the modeling of a paper so the students can write a paper during the vertebrate unit

✓ Learn the structure and physiology of representative organisms (weekly quizzes and labs)

Introduction:

Show representative slides from the Great Barrier Reef, Australia. Ask students to individually list the different organisms they observe in the slides. Then the students are to determine (in their cooperative group) the number of different animals observed. Go on to the next slides repeating the same procedure. On the last slide have the students draw the organism as they see it.

Development:

1. Students are to briefly write their observed differences between invertebrates and protozoans.
2. Lecture while students take notes using the Cornell method. Weekly labs of representative organisms are timed to help the student understand the features of the phyla being studied. After each lab dissection, assign students to compare and contrast this organism to the last organism studied. After each dissection, ask each student to write in their notebooks, "A Day in the Life of _____."

-
3. Students will read related articles on invertebrates, using the reading log format in their notebooks. They will also watch videos using the video format of write down 10 facts, write down 10 questions.

Culmination:

Present a narrated slide show on the Great Barrier Reef explaining how the organisms felt, where these organisms were found, and some facts relating to their character and habitat.

Assignment:

Students are to compare and contrast invertebrates to protozoans. This will be done cooperatively to get a best effort copy.

Students are to observe me modeling a paper on one invertebrate. They will grade my paper using the same grade sheet that I will use on their paper on a vertebrate to be done in the next unit.

Evaluation:

- ✓ Weekly lab grades
- ✓ Weekly quizzes over lecture and labs
- ✓ Grade on their comparison paper
- ✓ Grade on their grading of my paper
- ✓ Unit test (multiple choice, essay, drawings)

Ideas for notebooks:

1. Use spiral bound book - number each page first 10 blank for the "Table of Contents" as the year progresses
2. Make a book

3. Glue pictures into notebook (hand-outs).
4. Develop pride in notebook by using color, drawings, etc.
5. Notes - lectures
6. Lab observations/experiments
7. Journal
8. Reading log

My evaluation of the unit:

1. I think that this unit was a good precursor to the unit on vertebrates.
2. Modeling the research and writing of the paper on the invertebrate in segments throughout the unit worked well.
3. Having the students grade my paper (with mistakes in it) helped them to see what was required and the effort expected from not only myself but from their peers as well.
4. Students enjoyed the Cornell method of note taking where they were to make comments or ask questions in the margin.
5. They are more active learners when asked to discuss with their A/B partner a concept and then write a statement in the margin of their notes.
6. The journaling and video notes actually incorporated into their notebooks helped me in my organization. I knew everything was in one place.
7. I intend to repeat the unit as written next year. ☺

To Learn or to Memorize: That is the Question

by Peggy Gant
Sparks High School
Sparks, Nevada



What role does writing play in facilitating the learning of science? Asked this question a year ago or even six months ago, I would have assuredly replied, "Writing is important, but is definitely not a primary mode of teaching science."

Looking back to every science course I had enrolled in, I remember a "teacher-generated, teacher-motivated, and teacher-owned" situation. The way to learn science was to read a chapter, listen to a lecture reiterating the "important" points of the chapter, partake in a "cook-book" lab, and take an end-of-the-unit exam which actually only tested one's ability to memorize and regurgitate facts which, by the way, were usually forgotten within a week. After all, room had to be made for all the new details found in the next unit.

This method of teaching science has been around forever and seems (up until now) to be the "tried and true" way to produce budding young scientists armed with a myriad of facts and concepts. Undoubtedly, we have been producing students armed with facts with no guarantees, however, on how long they will remember these facts or even more important, whether they will be able to use them creatively or to communicate their knowledge intelligibly to others.

This is where the process of writing in science can "come to the rescue."

Teaching science through the process of writing changes the picture I have just painted in a dramatic way.

First and perhaps most important, the center of action shifts from the teacher to the student, which is where it must be if true learning is to occur. The teacher becomes a facilitator versus a "spouter" of knowledge, and the student in turn becomes an active participant in the learning process rather than a passive recipient of facts.

The fuel which feeds this new mode of learning is *student ownership*. Each assignment becomes a means of individual expression. This allows the student to feel more like a person and less like a number in a role book. I am seeing a new and more sincere relationship develop between my students and me as a result of the writing they are doing.

Perhaps the most important result of student ownership is *motivation*. When a student feels that he or she "owns" a piece of the lecture, plays a part in the classroom setup, and is being evaluated on something that is truly an individual expression of himself, he is much more likely to play an active role in the learning process. Not only have I noticed an overall increase in student enthusiasm for the subject matter at hand, but a definite improvement in the quality of the assignments completed.

I firmly believe writing should be an integral part of every curriculum. Writing makes students *THINK*. To me, this is the most valuable and vital ability in which a student can ever hope to excel. The writing process allows the student to analyze exactly what he knows about the subject at hand, while at the same time revealing the depth of his understanding. Explaining a scientific concept to an audience rather than the teacher forces the student to dive into the particular topic and know it inside and out. An evaluation tool such as this has another important advantage over the traditional "fill-in-the-blank" worksheet. It allows the student to express his or her feelings on the topic. Once individual feelings have been associated with a concept, it becomes much more difficult to forget.

Note Taking - Note Making is an excellent way to further aid retention because students are analyzing and injecting feelings about what has been said into their notes rather than just copying material and memorizing it.

I have always been a very lab-oriented science teacher. I believe that the "hands on" approach not only acts as a tool to generate enthusiasm, but also as an aid to improve understanding and retention of a specific concept. Incorporating writing into these labs has enhanced these positive points. By placing emphasis on *WHY*, students are again forced to analyze the process rather than search for the "correct" answer. Again, writing makes students think.

Can it be? Is this new mode of teaching science total bliss, entirely devoid of any drawbacks? Indeed this is not the case. The problems I anticipated, however, have been more numerous than those I have actually encountered.

Perhaps the biggest obstacle to overcome in using this technique is stepping out of one's "comfort zone" into the unknown. Most of us have a certain teaching style which we feel is safe, comfortable, and "effective." Why mess with perfection? The way to overcome this fear may be to incorporate some of these new techniques slowly, a few at a time. As these meet with success, it becomes easier to weave more and more writing into one's traditional curriculum.

A second anticipated problem is the added time needed to correct essay versus fill-in-the-blank evaluation tools. The use of "peer editing" and the rule of "all or nothing" has allowed me to use writing as a means of evaluation without increasing my correcting time. As Bob Tierney would say, "The secret is to keep the ball in their court as long as possible."

Many skeptics pose one last challenge to the use of writing in science. They think that the incorporation of writing into their curriculum will make it impossible to cover the numerous mandated concepts in a year's time. The answer to this dilemma becomes readily apparent. It is better to learn a few concepts well than to memorize many that will be forgotten days after being regurgitated on a traditional test. ❧

Taking the Plunge: Writing in Middle School Science

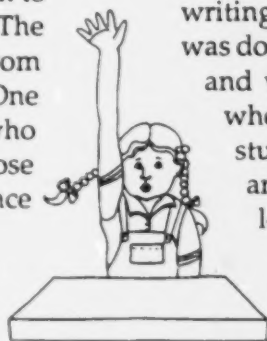
by Elizabeth Freitas

Yerington Intermediate School
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It was my first year of teaching at the seventh grade level after 17 years at the high school. I had been seeking some techniques to use to turn younger students on to science and to do critical thinking. The students in my classes ranged from above average to below average. One class section included students who were being mainstreamed or those who had not had exposure to science in the lower grades.

Trying a new technique was not easy. It would mean putting aside my safe, comfortable, automatic teaching methods and experimenting with methods which were as foreign to me as to the students. I decided to take the plunge and revamp my style of teaching and attempt to incorporate as many of the techniques as possible.

After attending Bob Tierney's class, I approached the principal and described the techniques and activities I would be using. Selling the idea to the principal was the easy part. The hard part was getting the students to accept the new approach. The reaction of the students was mixed. Surprisingly, it was the above-average students who balked or seemed threatened by the change. Eventually, they agreed to give it a try until the spring break. On April 15, the classes were polled to see if we should return to the "old way." Only four students opted for the "old way." This was incentive enough to continue to develop and make adjustments in the course for the next school year.



The techniques I introduced and have expanded on include the following:

Daily Log: Each student takes a turn at writing the log. It includes everything that was done in class: assignments, both reading and writing, new vocabulary words and whether a test or quiz was given. A student who is absent must check the log and if something is unclear must ask the log maker for an explanation.

Brainstorming is used to introduce a new unit. This is used to ascertain what the students know about the unit. Each student lists 20 words that come to mind when they hear a particular word from the new unit. They are given four to five minutes to complete the list. Next, the students write a paragraph using words from the list. No more than two words from the list can be used in each sentence. To receive points, each student must use and underline 10 words from the list. They must have at least five complete sentences in the paragraph. Students have five minutes to write the paragraph, after which each student reads aloud what he has written, and the other students discuss the facts that pertain to the new unit.

Flash Cards are used for the vocabulary. Two new words from the unit and their definitions are introduced each day. The following day all the previous words are reviewed along with the new words. By the end of the unit all words pertinent to the unit have been

reviewed at least three or four times. Students either write or give the definitions orally using complete sentences.

Round Robin is an exercise used to review for a major quiz or unit test. The students begin by writing a paragraph on the unit topic. At the end of five minutes the student passes his paper across to the next student. That student must read the written paragraph and continue writing about the subject. No information can be repeated. Three different students read and add to the original paragraph at five minute intervals. The paper is returned to the original student who must read all the paragraphs and indicate whether any information has been repeated. Students can earn five points if there are no repetitions. I check random papers.

Study Groups: This concept took about three weeks to get started. Finally, one student started to come to school early to study. Little by little the group grew. Last year there were eight regulars who arrived between 7:30 and 8:00 a.m. to review notes and vocabulary. On mornings when a test was scheduled, the groups were larger. This school year the groups meet from 7:30 to 8:00 a.m. and from 3:00 to 3:30 p.m. on Tuesday, Wednesday, and Thursday, with 8-10 students per session. They are open-door sessions with students coming and leaving whenever they want.

Note Taking - Note Making is a technique that takes time for the students to master. The process, though simple for high school students, becomes complex for the seventh grade student who is not familiar with having the freedom to write his opinions or ideas in his notes.

Students fold the page in their notebooks lengthwise, forming two columns. The left column is labeled *Note Taking* and the right column is labeled *Note Making*. The *Note*

Taking column is referred to as the teacher's notes and consists of the outline the teacher puts on the board while lecturing, using as many of the vocabulary words as possible. Each segment of my lecture is eight minutes long (a kitchen timer has become this teacher's third hand). The students are then given two to three minutes to do *Note Making*. During this time the student uses the left column to write definitions for vocabulary words, to list information given by the teacher but not included in the teacher's outline, to diagram a concept or simply to write personal notes such as "This will be on the test," "Know this for a quiz," or "Double check this in book," etc. Students are not merely to copy the teacher's outline into their column. I stress this while checking their work during the two to three minutes of *Note Making*.

The students' notebooks are collected and checked for *Note Making* and the vocabulary list. The vocabulary list is placed on one or two separate pages at the beginning of each unit's notes. This helps organize their notes and improves study skills.

Notebooks are checked at three to four week intervals (weekly during the first weeks of implementation) and the students can earn five bonus points for a complete notebook. The students who understand the mechanics of this activity have indicated that their notes were easier to study.

Testing: Standardized tests are used as major quizzes. The standardized tests consist of true/false, multiple choice and completion questions. Essay tests, used at the end of each unit, consist of two questions. Each answer is close to one-page long.

In order to determine whether there was a relationship between the type of test given and the grade received by the students, the following experiment was conducted. I used standardized and essay tests. In addition to the two types of tests given, I also considered

whether the students had knowledge of an upcoming test (affording an individual the opportunity to study).

All four tests involved in the following experiment were taken by the same class (a

life science class). The students spanned the spectrum of perceived intellectual talent.

A .1 significance level was used in both experiments.

Experiment 1

Material to be tested was covered in class. Students knew beforehand that they would be tested on the material on a disclosed date. The standard test and the essay test involved were given a week apart.

Experiment 2

Material to be tested was covered in class. The students did not know beforehand when they would be tested on the material. Again, the standard test and essay test were given a week apart.

Results

For both experiments, the average grade on the essay test was higher. This could be due to the essay test being more subjective. Regardless, to me the essay test is a better indicator of how well a student understands a concept when he can explain it in his own words in writing. Having prior knowledge of the test dates did not seem to make too great a difference on test scores.

New techniques or activities do not catch on immediately and there are times when I've been tempted to return to the "old ways." Then I remind myself about the change I see in the students and it becomes worthwhile. The students in the lower group no longer feel inferior to their peers because they are doing the same things and their self image has improved.

The study group and group work in class both give the students the opportunity to help each other in a positive, productive way. The flexibility the techniques afford is endless and every class can be an exciting new learning experience. Both the students and I have grown and will continue to grow from this experience. ♡

Finally Someone is Doing Something About the Weather!

by Don Sondag

Kate Smith Elementary School
Sparks, Nevada



Before taking Bob Tierney's workshop, I would likely have agreed with the statement that one writes to express knowledge. After considering several of the activities presented to us in the workshop, I would be more likely to say that one writes to discover knowledge. More than once I found that during the process of writing one can learn very quickly what one knows, and just as important, what one doesn't know.

At the elementary level, finding out how to write might be as valuable, or more valuable, than what is written by a student on any given day. If emphasis is to continue on the process skills, the product over a period of time will begin to take care of itself.

The writing process in the content areas such as science can be justified on at least six different points:

1. Students have to organize their thinking on the subject to write
2. Writing will force them to sort out hazy understandings
3. Students focus on important information
4. Questions raised in the process or writing can be answered
5. Manipulating the ideas on paper is likely to help the student remember more
6. A long-term contribution to writing skills of any kind is beneficial in all areas.

Fourth Grade Weather Unit **Writing Activities for Studying Weather and Climate**

Major Topics:

- I. The atmosphere
- II. Observing the weather
- III. Weather forecasting
- IV. Air movement - wind - air masses
- V. Water in the air
- VI. Violent weather/storms
- VII. Polluting the atmosphere

How to Begin:

1. Each student will write out one complete sentence about something the student already knows about weather. Samples of these will be put on sheets of paper and placed on a bulletin board. As we go through the unit these statements will be rewritten so they are as close to the truth as possible.
2. Working in groups of three, students will cluster around the word "weather." At the end of the unit they will be given the same activity. The first clusters will then be compared with clusters after finishing the unit.

Activities:

1. Your hot air balloon breaks from its tether. Describe your trip as your balloon carries you through the layers of the atmosphere. Use vocabulary words such as air molecules, oxygen, troposphere, stratosphere, mesosphere, ionosphere and temperature.

or:

Draw a picture of the layers of the atmosphere surrounding the earth. Write one complete sentence containing factual information on each of the four layers. Use mile markers to show how high each layer extends.

2. Each student will complete a chart on how weather and climate affect the following: housing, earning a living, recreation and leisure time, transportation, consumer purchases of goods and services.
3. Each student will keep a daily journal from our weather band report on these statistics: 12 Noon temperature, wind speed, wind direction, cloud type, precipitation, barometric pressure, relative humidity. This will be kept for the entire length of the unit (four weeks).
4. Any student who summarizes an important weather-related story from around the world as reported in a newspaper, news broadcast, or magazine will earn ten extra bonus points.
5. Collect a class list of laws relating to the weather.

Examples:

- (a) no campers are allowed on Highway 395 during wind warnings
 - (b) chains or snow tires are required on certain mountain passes during storms
 - (c) watering lawns is governed by even and odd house numbers during periods of drought
 - (d) studded snow tires must be removed by April 15
6. Each group will be required to write out one question to pose to Sam Shad, a local T.V. weatherman and our guest speaker.

7. Each student will write out a personal comment on the daily weather as recorded in Activity 3. This will be a part of the weather journal.

8. Each student will do one of the following:

Tell of a time when he/she encountered a significant storm

or:

Provide an interview with someone who has encountered a violent storm such as a hurricane, blizzard, or some similar weather and how it affected them.

9. Each group will contribute to a class list of weather superstitions such as "The groundhog sees his shadow," "A dog eating grass means rain," "If March comes in like a lion, it will go out like a lamb," or "The woolly bear caterpillar indicates winter weather."

10. From a list of two hundred possible cities, each student will pick one city to represent. Using weather information from the Places Rated Almanac (Boyer and Savageau, published by Rand-McNally and Co., 1985) the student will represent the tourism department of the chosen city. Using hand-drawn maps, charts, and graphs, posters or pictures, students will write a report trying to "sell" the city to the rest of the class as tourists as a prime destination for travelers.

11. Using the weather summary board, write out a report of the weather as it would be given TV (for the local area). Include predictions of the next day's weather.

or:

Pretend that you are visiting another city. Using the current USA Today weather map, write us letter telling us what you are doing.

Be sure to include the weather conditions using science words we have learned in the unit.

12. Each student will draw a version of a scene depicting three steps of the water cycle, using complete sentences to describe what happens in each of the steps.
13. Each student will compose a weather-related riddle or questions dealing with facts or information from the textbook or encyclopedias. (Students must provide the source of their information.)

Example:

Q: What location in the United States is the driest?

A: Bagdad, California, with 3.93 inches total rainfall in five years

Q: What location is the wettest in the world?

A: Cherrapunji, India, with 1041 inches of rainfall in a record year

14. Given a chart, each student will chart the types of clouds for one week and in

sentence form will note the type of weather on each of those days. Students will also estimate the percent of cloud coverage.

15. Make a variety of chalk or pencil rubbings to simulate cloud formation

or:

Formulate a series of five metaphors which use the wind as their basis.

16. Use the Reno newspaper to chart the pollution index for a one-week period. Write a short paragraph on possible ways to reduce air and water pollution in Washoe Valley/Truckee Meadows.
17. Write a paragraph defending or protesting the use of wood-burning stoves in the Reno/Sparks area.
18. Fifteen films have been ordered for this unit. Each student will fill out a film review sheet for all the films that are used.
19. Field trip to weather bureau, Reno airport: Each student will write a synopsis of what they remember/learned during the field trip. ☼

Reflections of a Fourth Grade Teacher: The Writing Process

by *Sheilla Kiley*

Lovelock Elementary School

Lovelock, Nevada



"But teacher, I can't do this. I don't know what to say."

How many times have you heard those words?

How many times have you given a writing assignment only to look around and see students chewing the end of their pencils or staring forlornly at the blank paper, unable to find that so important first word?

Before I became involved with the Northern Nevada Writing Project, I suffered for the students who hated to write. What a miserable feeling of frustration they had, adding to their already sagging self-image. And then, bless their hearts, if they did finally manage to put down something on paper, I felt it my beholden obligation to put red marks all over it.

I have always felt writing is a doorway to learning, a way to improve thinking skills. But how could that be true for those poor little monkeys who dreaded it so?

Since those early teaching days, I have learned a great deal about the writing process. Most important, I have learned that writing must be done in an atmosphere of trust - trust between student and teacher, and trust among the students themselves. Adding to the atmosphere of trust were techniques for prewriting that made it easier

to put those first scary words on that white pristine paper.

I have also learned techniques for developing fluency. One of my favorites is called the "Minuter." The students early in the school year are given a topic, 30 seconds to think, and a minute to write. The special rule is they may not allow their pencil to stop, regardless of what they write. We do this for several days, writing and sharing with a partner or with the group if they wish.

What the students don't realize is I am increasing the time by a few seconds each day. By the end of two weeks they can write for five full minutes with little difficulty. Listening to their writing is great. They love to hear the different approaches others take to the same topic, something as prosaic as telephone or pizza.

The importance of audience in the writing process is something else I learned in the writing classes. Now I try to provide my students with as many different audiences as possible. They write for others, not just for me. Tied into writing for others is the importance of publishing what they write. I have stolen many good ideas!

Lastly, I have learned how much more everyone, myself included, enjoys writing if it is something we do together. We write together, we work on it together, we are proud of our product together! And seldom do I hear, "But, teacher, I can't do this. I don't know what to say." ❧

Natural Selection Using the Peppered Moth as an Example

by Steve Feasel

Carlin High School
Carlin, Nevada

I have divided the lesson into four sessions or days.

Session One

Word of the day: *Natural Selection*

Have students draw a line segment and have the the put an "X" on the line to indicate how much they know about Natural Selection.

Begin the lesson with a lab activity. Before starting the activity, give a brief explanation about the peppered moth that exists in England. These moths are active during the night and rest on tree trunks during the day. Before England had many factories, most of the moths were light-colored. As the factories increased their production, soot began to coat the bark of the trees. After a time, most of the moths were dark colored.

Allow students to select a partner and instruct them that one of them is going to be a scorekeeper and timer, the other a bird. The scorekeeper should construct a data table to keep track of the generations of moths, the number of moths eaten, and the number that survived.

Example:

	Dark	Light
Generation		
# eaten		
#survived		

Each pair of students will need a black sheet of paper, one meter square, and 150 white and 150 black triangles. Place the one meter sheet of black paper on the floor and tell the students that this paper will represent the bark on a tree. While one student is not looking, the other will randomly scatter 30 white and 30 black triangles on the paper. These will represent the first generation of light and dark-colored moths. The other student will have 15 seconds to "eat" (pick up) as many moths as possible.

At the end of 15 seconds, count the number of black and white moths that were "eaten" and record the results. Subtract the number eaten from the number of moths in generation 1 to find the number of survivors.

We will now assume that the survivors reproduced and doubled in numbers. On the data table, double the number of survivors from generation 1 to generation 2. On the black paper, the time keeper will scatter an equal number of colored triangles as there were survivors. He/she will do this for each color. This will double the population for the next generation because the survivors are still lying on the paper. Repeat this procedure at least five times, each time representing a new generation of offspring. After completion of the activity, instruct the students to write answers to the following questions:

1. You began the activity with equal numbers of dark- and light-colored moths. What is the difference between the colors now?
2. Was either colored moth able to increase in number over the five generations? Which color?
3. Did either colored moth decrease in number over the five generations? Which color?
4. Why was one colored moth more likely to be eaten by a bird than the other?
5. Was either colored moth completely safe from the bird?

Allow students to complete these questions at the end of the lesson.

Session Two

Lecture - limited to 10 minutes

Notes to be taken: "note taking - note making."

Nature has its own selection process. In nature, only certain organisms in a species reproduce. Only the genes from these organisms are passed to the next generation. Thus, nature has its own selection process. Which organisms reproduce and pass their traits on to their offspring? a theory called Natural Selection gives a possible answer.

At this point, I feel that a complete written lecture would be impractical because information about Natural Selection can be found in just about any text on biology. I do feel that certain ideas should definitely be included in the lecture and will only summarize these.

The theory was proposed by two men, Alfred Wallace and Charles Darwin. Darwin was given credit because he went as far as publishing his information in 1859. He developed the theory to explain what caused changes in organisms over thousands of years and divided it into five main

parts.

1. Organisms produce many more offspring than can survive and reproduce (Examples).
2. The over-production of offspring leads to a struggle for existence (Examples).
3. Variation - no two offspring are exactly alike (Examples).
4. Survival of the fittest (Examples).
5. Those organisms that survive and reproduce pass their traits on to their offspring.

It's possible that each of these five main points, after giving examples and explanations, may be complete 10-minute lectures, each following the same procedures and possibly developing more "word of the day" activities.

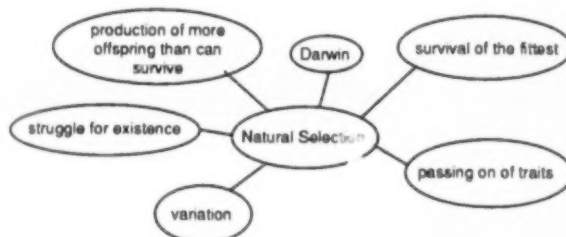
Have students spend five minutes writing questions in the "note making" section of their notes and then ask for their notes to help prepare your next lecture from their questions.

Session Three

Have students brainstorm, first by themselves, then as a class, their ideas of Natural Selection

Example:

After clustering the ideas of Natural Selection, have the students return to the questions that were asked at the completion of the peppered moth activity.



Discuss the questions, trying to relate the answers to Darwin's theory.

Session Four

Ask students to write an explanation describing how the change in the color of the peppered moth occurred by using the ideas presented in Darwin's theory of Natural Selection. Allow them to use their notes.

After 10 or 15 minutes, have them trade their papers with a partner and try to make any corrections and additions necessary.

After five minutes, have the papers returned to their owners and ask them to rewrite their papers to be handed in, along with their original draft, for correction by the teacher.

Have them return to the line segment and put another "x" on it to indicate how much they now know about Natural Selection. ¶



Writing for a Different Audience

by Diane Olds

Elizabeth Lenz Elementary School
Reno, Nevada

My fifth graders wrote science books for primary grade students (kindergarten, first, second, and third grades). The assignment was designed so that the authors would have a different and real, audience. We had been studying the body—specifically, each of the five senses, the muscular system, the skeletal system, and the brain. I divided the class into groups of four and allowed them to choose one of the eight topics. Their task was to explain their subject in a way that could be understood by children in the age range five to eight. Students would have to clearly understand their material in order to simplify their explanations for a younger audience.

The groups began by taking notes on their assigned topic. Through discussion, they decided what ideas would be taught to the younger children and what language would be appropriate. They were also refining their understanding of the subject. They then met with me to orally outline their plans.

The next step was for them to write a "dummy" book, with their written text and rough sketches of their illustrations. They met with me again to discuss their "dummy." We worked together to simplify their language or clarify their ideas.

They were then required to receive responses from two other groups, so they could obtain positive feedback and decide where they needed more information. At this point they were able to make any changes they felt were necessary for their

material to be understood by their prospective audience. Because they had to simplify the vocabulary and concepts, they demonstrated thorough knowledge of their subjects.

As they worked on these various stages, I circulated among the groups to offer response or assistance and to gain a sense of the mastery of their topics. When they felt their first draft was complete, I helped them edit their books. The writing and illustrations were to be large enough to be seen by their audience during the presentations, and so were done on large sheets of tagboard.

"Most of the teachers commented that my students were 'regular little teachers' and in complete control of their material."

After completing their books, the groups met with me to rehearse their presentations. I focused on the less able members of the groups, asking specific questions about the texts of their books. The weaker group members were able to answer my questions as well as the stronger group members. At last they were to be allowed to venture into a real classroom and read their books and teach their lessons.

The students were assigned to read their books to a class. Some of the groups designed sensory experiments for the audience, i.e., taste and touch activities. The teachers in the other classes reported to me that the students competently presented their lessons and were able to field questions posed during the question and answer sessions. Most of the teachers commented that my students were "regular little teachers" and in complete control of their material.

Although only one presentation per group was required for their science grade, the groups begged to present their lessons again; each group ended up doing two or three lessons. They continued to beg to do more presentations. I finally had to tell my students that the unit was over, since they had already done ap-

proximately 20 lessons for eight classes, including the special education unit of autistic children.

The excitement they demonstrated about their learning experience was a joy to behold! In addition, I heard students discussing their knowledge, not only during "science period," but at other times of the day. Many of my students voluntarily gave up recesses to work on their projects, even some of those same children to whom recess is the most important part of the day.

Writing for a different audience helped to clarify many of the concepts for my students; it also gave them a sense of pride in their work. There was not a child in my room who seemed to be unhappy about or resistant to this assignment. ☛

A Lesson Unit Incorporating Writing to Learn Ideas

by Sharon Williams

West End Elementary School
Fallon, Nevada

Concepts:

Nutrition, Exercise, Cleanliness, Rest

Question:

What kind of a balance works for me?

Audience:

Concepts to be explored by a third grade class

Related Activities:

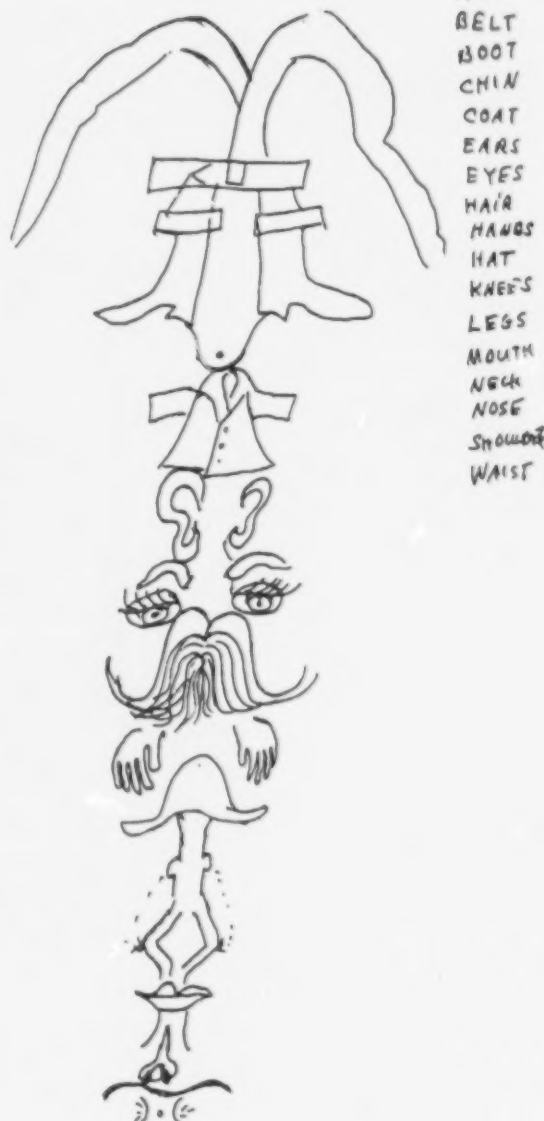
Using a cartoon of a lady with labels pointing out several body parts, have the students alphabetize the words on the labels on a sheet of drawing paper. Students are then to redraw the cartoon lady in the same alphabetical order.

Ask students to write what it would be like if they were so assembled!

Next have the class locate the labeled parts above in the index of their science books and in other resource and reference material. Give them time for research; have them read all they can find.

Again, have the class write, this time about why they think they are in the shape they are. Allow them to include in their writing a list of what they like about themselves and their bodies with a way to change what they feel could be improved.

Play enhancing background music like "Connecting Bones," perhaps around Halloween, to in-CORP-orate music and the season. ☺



The Write Way to Learn Math

by Terry Terras

McQueen High School

Reno, Nevada

Evaluating Expressions

In your notebook, evaluate the expression that is on the board. You have 1.3 minutes.

Time is up; now who has an answer?

Today we are going to use the order of operations and the use of grouping symbols to evaluate expressions.

Now take 2.7 minutes, and in your journals write the steps or order that you used to arrive at the answer you have for the problem on the board.

(2.7 minutes) Stop! Who will read their steps to me (Pick someone to volunteer if necessary.) Who's next?

(Alternate)

If the preceding is not successful in showing two or more ways of computing then write $5 \cdot 6 + 3$ on the overhead and show different ways of computing.

To have meaning, each numerical expression should have a unique value. What should we do?

$$5 + 2 \cdot 3 + 16 \cdot 0$$

Record answers on the board.
(Should have at least two.)

Objective

Record on the board. Hopefully, there will be two or more sets of steps.

$$\begin{array}{r} 5 \cdot 6 + 3 \\ 30 + 3 \\ 33 \end{array}$$

or

$$\begin{array}{r} 5 \cdot 6 + 3 \\ 5 \cdot 9 \\ 45 \end{array}$$

Solicit possible solutions from students.

By international agreement we have the following order of operations.

1. Evaluate all powers.
2. Do all multiplications and divisions from left to right.
3. Do all additions and subtractions from left to right.

Now let's look at a problem that may be a little more complex. What is the first step? Put the completed example in notebooks.

2.75 minutes to do this problem. (After 2.75 minutes) Work in groups of three.

The last example is the fraction bar. What's first? Next? etc.? Put in notes.

Use overhead.
Students should include in notes

$$2 \div 3 [8 (a-b)^2 + 3b] \text{ if } a = 5, b = 2$$

$$2 \div 3 [8 (5-2) + 3 (2)]$$

$$2 \div 3 [8 (3) + 3 (2)]$$

$$2 \div 3 [8 (9) + 3 (2)]$$

$$2 \div 3 [72 + 6]$$

$$2 \div 3 (78)$$

$$52$$

$$2 \div 3 [8 (a-b)^2 + 3b] \text{ if } a = 6 \text{ \& } b = 3$$

$$(54)$$

$$\frac{b^2 - 2}{b + x^3}$$

$$\text{if } b = 5 \text{ \& } x = 3$$

$$\frac{5^2 - 2}{5 + 3^3}$$

$$\frac{25 - 2}{5 + 27}$$

$$\frac{23}{32}$$

You have 1.9 minutes to do the next two problems. (After 1.9 minutes) You may work in groups of three.

Now take the next 4.1 minutes and write a brief essay on what you have learned today that was new or what you may still be having problems with that we went over yesterday.

Start homework assignment in class.

Using the rules, solve the following problems. Spend 1.9 minutes working on the problem without help. Then you can work in teams of three and help each other.

How do we go about evaluating an algebraic expression such as the one on the overhead? Solicit possible steps to take and use it as an example.

Now you have 2.1 minutes to do the following problems in your notebook. (After 2.1 minutes) Work in groups of three to solve.

In math, grouping symbols are used to clarify or change the order of operations. What do you think a grouping symbol is? Show an example.

$$a^2 - 5$$

$$a + x^2$$

1. $a = 6$ and $x = 2$

2. $a = 5$ and $x = 4$

Collect this sheet and read, initial, comment, etc.

P. 7 problems 2-16 even

P. 8 problems 1-24, 26-46 even

1. $12 \div 3 \cdot 5 - 4^2$ (4)

2. $14 \div 7 \cdot 2 - 3$ (1)

3. $64 \div 8 - 3 \cdot 2$ (2)

4. $13 - 2^4 \div 4 + 2$ (11)

Put one problem on the overhead projector, then go on to the next problem. Class - work out problems in notebooks. If students do not have problems, go on to the next example

$$2x^2 + 5xy \quad \text{if } x = 3 \text{ and } y = 2/3$$

$$2x^2 + 5xy$$

1. if $x = 4$ and $y = 3/4$ (47)

2. if $x = 7$ and $y = 3/25$ (101)

3. if $x = 1/2$ and $y = 3$ (8)

$5 \cdot 6 + 3$ means $30 + 3$ or 33

$5(6 + 3)$ means $5 \cdot 9$ or 45

The basic grouping symbols are:

parentheses ()

brackets []

fraction bar $\frac{a}{b}$

Grouping symbols indicate that particular expression should be treated as a single value and should be evaluated first. When more than one symbol is used, start with the innermost grouping symbols.

Using the rules we have so far, order of operation and grouping symbols, how would we evaluate these expressions? Put examples in notes.

Questions? Good. Now you have 3.6 minutes to evaluate both of these expressions. (After 3.6 minutes) Work together in groups of three.

Students are to put information in their notes.

$$3(2 + 5)^2 \div 7$$

$$3(7)^2 \div 7$$

$$3(49) \div 7$$

$$147 \div 7$$

$$21$$

add $2 + 5$

evaluate 7^2

multiply 49 by 3

divide 147 by 7

$$3(3 + 7)^2 \div 5$$

$$27 \div 3(5 - 3)^2$$

$$(60)$$

$$(36)$$

Teacher will move among students to check work. ☺

First Graders Meet the King of the Terrible Lizards

by Mary Sheron

Northside Elementary School

I am a first grade teacher in Fallon, Nevada. First graders are just learning to read, so most science projects are done together in class. One of my favorite units (and a student favorite, too) is the following one-day lesson plan on dinosaurs.

1. I begin by saying:

"Today we are going to take a walk to Dinosaur Land and learn about a dinosaur who was the 'King of the Terrible Lizards.' As we walk, be sure to look out for the swamp!"

I play some "dinosaur" music while we pretend to walk to a special spot in the room where all the children sit on the floor.

2. I hold up a large card with the name Tyrannosaurus Rex printed on it.

I have the students:

- a) spell the name together,
- b) listen to me say the word, and
- c) say the name together.

3. I show the students a picture of Tyrannosaurus Rex.

4. We discuss what Tyrannosaurus Rex was supposed to have looked like, including its very large head, large body, sharp teeth, short front legs, and powerful back legs.

5. I will read two or three short articles, with pictures, about Tyrannosaurus Rex. The students then pretend to go back to their seats from Dinosaur Land.

6. On a large sheet of white paper I will list the important facts we have learned. It may look something like this:

Tyrannosaurus Rex

Meat eater

Large teeth

Short front legs

Strong back legs

Large head

7. The students will write one sentence about what they have learned about Tyrannosaurus Rex, and will then illustrate their writing by drawing a picture of him.

8. Somelater activities would include:

- a) making up a story about their own make-believe dinosaur. This would be done in small groups and then shared with the class.
- b) playing a game trying to decide which dinosaurs were meat-eaters and which ones ate plants.
- c) doing little quizzes with simple sentences students can read.

Example:

Who was known as "Thunder Lizard?"

Who had boney plates on his back?

By incorporating writing activities in each day's lesson, students will retain the information longer. ♣

The Search for Walter

by Patricia D. Fox

Yerington Intermediate School
Yerington, Nevada

I am a sixth grade teacher in Yerington, Nevada. In the morning I have a self-contained classroom. In the afternoon I teach science to all three sixth grades. I try to incorporate writing in my science classes and I have developed a number of lesson plans which utilize both science and writing.

For many of my students, this is their first formal experience with science. Consequently, I have found that they can be overwhelmed with standard sixth grade science, and are more successful with primary level science activities. Most of these activities are based on the *Great Explorations in Math and Science* series put out by the Lawrence Hall of Science. One of these was *Crime Lab Chemistry*.

Crime Lab Chemistry employs the process of thin layer chromatography to discover the pattern of a pen which wrote a "ransom" note. The original lesson plans were fairly basic:

1. Introduce the ransom note and pens.
2. Show students thin layer chromatography technique.
3. Have the students match the sample from the ransom note to a sample from one of the other pens.

I saw it as an interesting yet underdeveloped project.

I imagined what could be done with the precept of crime detection which was behind the experiment. My mind raced through ideas which ranged from Sherlock Holmes novels to the *Quincy* TV series. From the original and my ideas, I set out to develop a workable, creative, and writing-intensive lesson plan.

First of all I arranged for a "real" kidnapping. The victim was the classroom body parts torso, "Walter," who disappeared one night. The



culprits were unknown. The next class period I told the students to pretend they were recruits in a police academy, where they were rookies and I was a sergeant. I gave them a brief course in crime detection. This included note taking, questioning, and observation techniques. I also asked that the rookies keep a notebook about their first real case. In it they were supposed to note observations, deductions and clues.

Then I sent them to examine the scene of the crime and to question the Ms. Fox (myself) and her students (themselves) about Walter and the crime. I planted some clues in the classroom. These included a ransom note written in felt tip pen, and a series of numbered index cards hidden in books. The ransom note read:

I have abducted Walter. I am going to use him for experiments. I will give you two clues: I am a scientist and there are books which have been written about me.

The students (rookies) examined the room, found the ransom note and the numbered clues in the books; then they asked questions and took notes.

The next class period, as Sarge, I showed the rookies some pens which were "evidence" that the higher grade in the academy had collected from suspects. The pens were numbered and each number corresponded to the notes which had been placed and found

in the books. After I modeled the thin layer chromatography technique, I sent the rookies home with an assignment to write down the technique so that they could reproduce it "for real" on the evidence pens in their next class.

The analysis of all of the pens took two class periods, and the results were mixed. Few pairs of rookies matched my results. So I kept quiet and let them go on with their deductions.

At this point the students were perplexed. When Walter initially disappeared, they expected that the search for the kidnapper would be something like an Easter egg hunt (the closest simile I can make). In short, they didn't understand the clues. They didn't understand the connection between the numbered cards in the books, the pens, and the ransom notes; and they were frustrated. So I left my set lesson plans and had the rookies brainstorm together in groups with a concept map.

Somehow, one student found the connection and got a reasonable answer (if not the one that I had foreseen). He told his group, they wrote it down, another group saw their results and copied it; and soon the entire sixth grade suspected Albert Einstein (the original culprit had been Oppenheimer.).

Since they had arrived at a conclusion, and since they could support it, Walter reappeared just as mysteriously as he had disap-

peared. About a day later a letter was sent to my classes by Albert Einstein, explaining what he had used Walter for, and apologizing for not asking first.

I felt that these lessons had some strong points and some weak points. The strong points were that the students wrote, they were involved, and the process involved problem solving. One weak point was that the mystery was too difficult for most of them to solve. The second, and more irritating weak point, was that they couldn't appreciate the playacting aspect of "Walter's" kidnapping. They knew they weren't real rookies, of course, that I wasn't a sergeant, that Walter hadn't really been kidnapped (he was hidden), and that Albert Einstein was dead.

If I do this unit again, I will make some changes. I will give the rookies more training. I will make the problem easier to solve. And I will have them share and post their notebooks. But I do not know what to do about the student difficulty with play acting, for I find such a lack of imagination and pragmatism in children discouraging. Nevertheless I will continue to use play acting in lessons.

Currently I am working on putting out a newspaper filled with students' science contributions: write-ups on labs, facts, stories, questions, almost anything is welcome as long as it has something to do with science. I hope that it works. ¶

Human Body Systems

by Martha Harrington

Lovelock Elementary School
Lovelock, Nevada

OBJECTIVE:

The sixth grade student will independently identify, with brief definition/description, at least five major factors concerning the human body systems and parts from small group oral reports presented in class and from written summaries.

DAY 1:

I select and list on the board the body systems or parts for small group reports: muscular, skeletal, circulatory, nervous, endocrine, digestive, respiratory, hair, skin, ear, eye, and mouth. Students then volunteer for a topic.

I require an oral report from each group, with each person participating. The group must use at least three different references. I provide transparencies or ditto sheets of materials to help support the report if students request it. I also encourage activities that relate to the subject.

Students form groups and receive large sheets of paper for mapping present knowledge about their particular topic. I collect these maps for future reference.

DAYS 2 - 5:

The teacher shares resources, dittos, books, and transparencies as students work on their projects. I provide class time for library research, small-group discussion, and organization of the oral report. My role as teacher is to observe, answer questions, and provide guidance when needed.

DAYS 6 - 7:

Small groups present oral reports to the class along with any activities generated. I

evaluate the presentation on content, activity, organization, reasonableness of presentation, and contributions made by individuals.

DAY 8:

Each group receives paper to map their present comprehension of their topic, using a metaphor if possible.

DAY 9:

I return the original map (DAY 1) to each small group along with the newly completed map. The group compares, first in discussion and then in writing, the amount of information they have learned about their topic. The group writes a rough draft of the information. These drafts are exchanged between groups for proof reading. Each group then writes a final draft, which is signed by the group participants and given to the teacher..

DAY 10:

The second metaphor maps are displayed around the room. Students are given time to look at the maps with the understanding that they will write at least five major facts concerning each topic. Students are to keep in mind interrelationships within and among the systems, and "how" or "why" the systems/parts work. I list all the body systems and parts on the board, and write a statement of student assignment directions while the students are looking at the maps.

When students are seated, they will independently identify, briefly define, and describe at least five major factors about each of the topics. Final papers are evaluated by the teacher. ♀

A Survival Guide for Writing in the High School Science Class

by *Richard Matthie*

Sparks High School
Sparks, Nevada

These writing activities will be assigned in tenth grade life science classes.

CLASSROOM ASSIGNMENTS:

1. *Parent-corrected Textbook/home-work Assignment*

In class, students will do a short textbook question/answer assignment with the knowledge that it will be corrected by their parents. Parents will have received notification about this assignment. Because the student will be writing for a different audience (not the teacher), I am eager to find out what the response will be.

2. *Identify the Animal*

This is an activity involving two students and a folded piece of paper. Each student draws one half of an animal on one half of the folded paper. Then the students give the newly created animal a genus and species name and describe in writing its (imaginary) habitat.

From past experience with this assignment, I know that a lesson on environment and habitat must precede the activity.

3. *Summary of Assigned Reading*

Follow a short reading assignment with a written summary of the topic. Tell students in advance that their writing will be corrected by another student who will be selected at random. Use code names to conceal the author's identity. The stu-

dent will review the corrected paper and rewrite if necessary before it is handed in to the teacher along with the original paper.

4. *Have Students Describe Their Own Habitat*

Following an introduction of habitat by the teacher, students will be asked to write a description of their home and/or community habitat. This assignment may be done at the first of the term in order to learn more about each student.

5. *Bowl of Fruit*

This is a problem-solving activity or science lab. The students observe a bowl of mixed fruit and a bowl of water. Students write a lab that answers the question: "Which piece of fruit will float?" They then write about the following problem steps:

- ✓ The problem
- ✓ A hypothesis (including why)
- ✓ The procedure
- ✓ The results
- ✓ A conclusion

6. *Write the Procedure for Collapsing a Soda Can*

After students have done the activity causing a soda can to collapse, they must write out the procedure so that an elementary (fifth or sixth grade) student could follow it. Students will be writing from their experience and from the knowledge presented by the text and the instructor.

7. *Wall of Fame*

I will clear a section of wall and display outstanding student work in science.

8. *Four-square Descriptive Process*

I plan to use this activity to review the concept of the "cell." The students will divide a page of paper into four equal sections. In the upper left quarter they will explain what a cell is. In the upper right quarter, they will write that a cell is "most like a _____ because _____."

Students will share these similes with the class, looking for the most "far out" comparison. Then, in the lower left quarter, all students will describe what it would be like to be that "most far out _____." In the bottom right, they

will then rewrite the description from the upper left quarter, using the new information from steps two and three.

9. *Vocabulary Columns*

This is an activity that I have tried as a homework assignment at the end of the last two chapters. The idea is to decide which column the vocabulary word belongs in. For example, in the chapter dealing with the cell, the two columns were headed "structure" and "function."

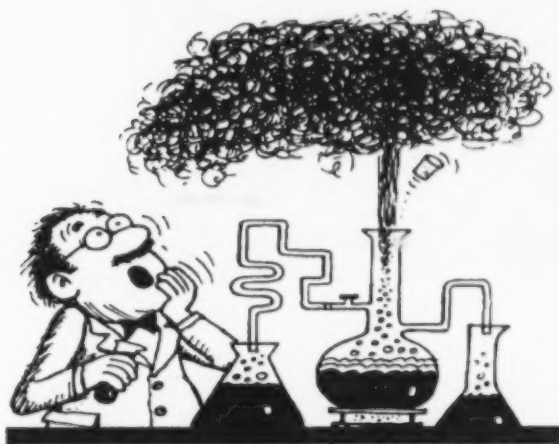
10. *Survival Guide*

The last week of school, I will assign the students the task of writing an eight-statement "guide" on how to survive my science class. The students will be instructed to arrange the statements in priority, one through eight. ¶

Writing in the Science Classroom

by Jim Blattman

Lowry High School
Winnemucca, Nevada



A number of years ago I taught biology and life sciences to a rather rough and not so academically inclined minority group. After a year or two of torture, I was able to purchase Harry Wong's *IIS Life Science* program which has many similarities to the *Writing for Science Concepts* program given by Bob Tierney.

In the *IIS Life Science* course students were to begin each day investigating single concepts by making observations and writing each observation as it was made. Then the students considered the relationships in the statements that they had made by rewriting their observations in a clearer and more interpretive style.

Finally, the laboratory, and usually the class period, ended with the students making an encompassing statement about the concept learned that day. It was a simple but amazingly effective way to teach students. I would begin the class period with a handful of pebbles and a few leaves and end it with a bunch of kids who understood the concept of classification with written proof of their new found knowledge.

Because of my experience with the IIS program's emphasis on writing, I recognized much of what Mr. Tierney said as what I knew to be successful, but had for some reason neglected.

Many of the laboratory exercises in chemistry and physics follow a format of observation, interpretation, and analysis. Observations become the initial writings, recording the happenings as they are sensed. Here students freely check one another's results. Lab partners each write their own observations and check one another's writing as well as those of other class members.

Interpretations take the form of the initial revision of the written thought. Students should not revise their observations to match those described in the text; they should be encouraged to restate their own observations in a clear and concise manner, relating their ideas to the concept being investigated.

Finally, as analysis, a student is often asked to write about the application of this concept and how the concept relates to a broader view of the topics being studied. Changing the emphasis from single-word answers to complete thoughts and requiring students to incorporate the ideas of others in their work gives them a greater challenge as well as increasing their understanding of the concepts.

If students have written out some sort of a sentence or two describing their ideas as answers to homework questions, I participate with them in discussions about the questions. They always seem to come partially prepared and I always have a pile of demonstration apparatus which correlates to

the assigned questions. We then engage in a lively conversation as I set up the demonstration and ask them to describe what is happening as we go along.

They then rewrite their answers to the homework questions according to what they have seen. Lately, I've begun to give more emphasis to lab partners reading their answers to one another and rewriting them as required. When the questions are graded, the students read one another's answers to each other and assess their scores. I am always amazed at how well this seems to work, and while they are doing this I busy myself preparing their laboratory work or clearing away the apparatus and debris that accumulates throughout the day.

I find that my students are far more concerned about what other class members see in their written work than what I as a teacher think of it. The number of students completing the written homework assignments dramatically increased when they realized that their work would be under the scrutiny of peer review. This leaves me free to say nice things about them and skim their papers briefly. Generally, most students get good

scores, and good papers are much easier to grade even when I do go over them closely.

Mr. Tierney's "Class Log" is a good idea for make-up work for students who have missed a class. I started requiring lab partners to keep an extra hand-out for their absent companions and making them responsible for telling the absent student about notes and assignments. It has helped to develop a friendly and caring relationship between lab partners, and students can get needed information with a minimum of class disruption.

Since I require notebooks of the hand-outs, notes, labs, questions, etc., each student has a learning or class log of sorts that is an easy display of the year's activities.

The writing exercises that I plan to institute are:

1. Write an autobiography of yourself as a scientist.
2. Draw a sketch map of the place you study and tell how effective it is.
3. Pair up and write as pro and con: "Why study science: chemistry or physics?"
4. Survival guide for next year's students. ☛

Deplagiarizing the Research Paper

by G. Marvin Caldwell

Cannon Jr. High School
Las Vegas, Nevada

For years, library research has caused problems for me, as many students have a tendency to plagiarize their research papers. In many classrooms, these papers are highly touted for their perfect form.

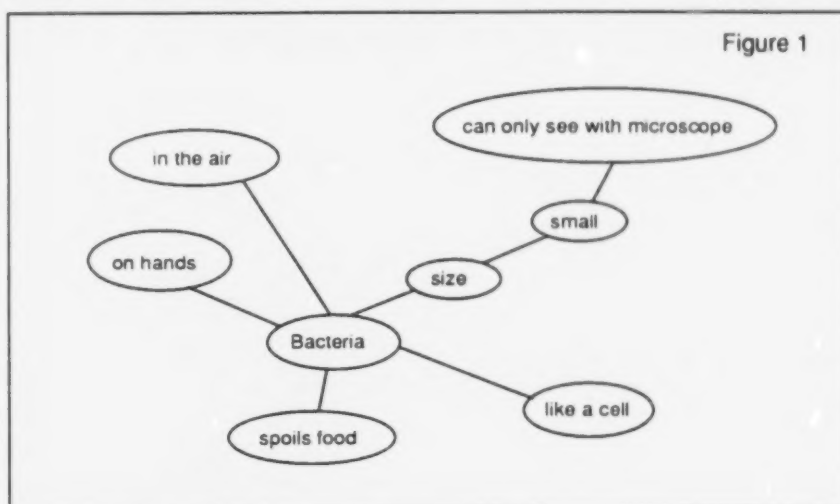
The problem is that the work does not express the students' abilities.

To overcome this obstacle I developed a method using library investigation that concludes with a short research paper. These papers reflect the students' abilities as well as their newly-acquired knowledge of their topics. This method has been successfully used with both ninth grade honors biology and and heterogeneously-grouped seventh grade life science classes.

Assigning topics is always a challenge. For the seventh grade student I try to keep the topics simple and related to life science. Ninth grade students require more depth. A greater variation of topics within a class increases the availability of research material; consequently, a topic should not be used by more than one student per class.

I assign the topic, then tell the students to write their topics in the middle of a piece of paper and circle the word. They then bubble in (cluster) everything

they know about their subject matter (see Figure 1). I collect this paper and save it to be compared with the final draft. Since each student will have expressed his knowledge of his topic, the bubbling or cluster may be considered a pretest or a



gauge of what the student knows about his/her subject.

On the second day, the students spend the period in the library researching their topics. These rules are followed:

1. The students may not check out any books.
2. The students may not photocopy any information.
3. All notes are to be taken in bubble (cluster) form.
4. Only ideas are to be expressed in writing—no complete sentences.
5. Bibliography information is listed on bubble sheets.

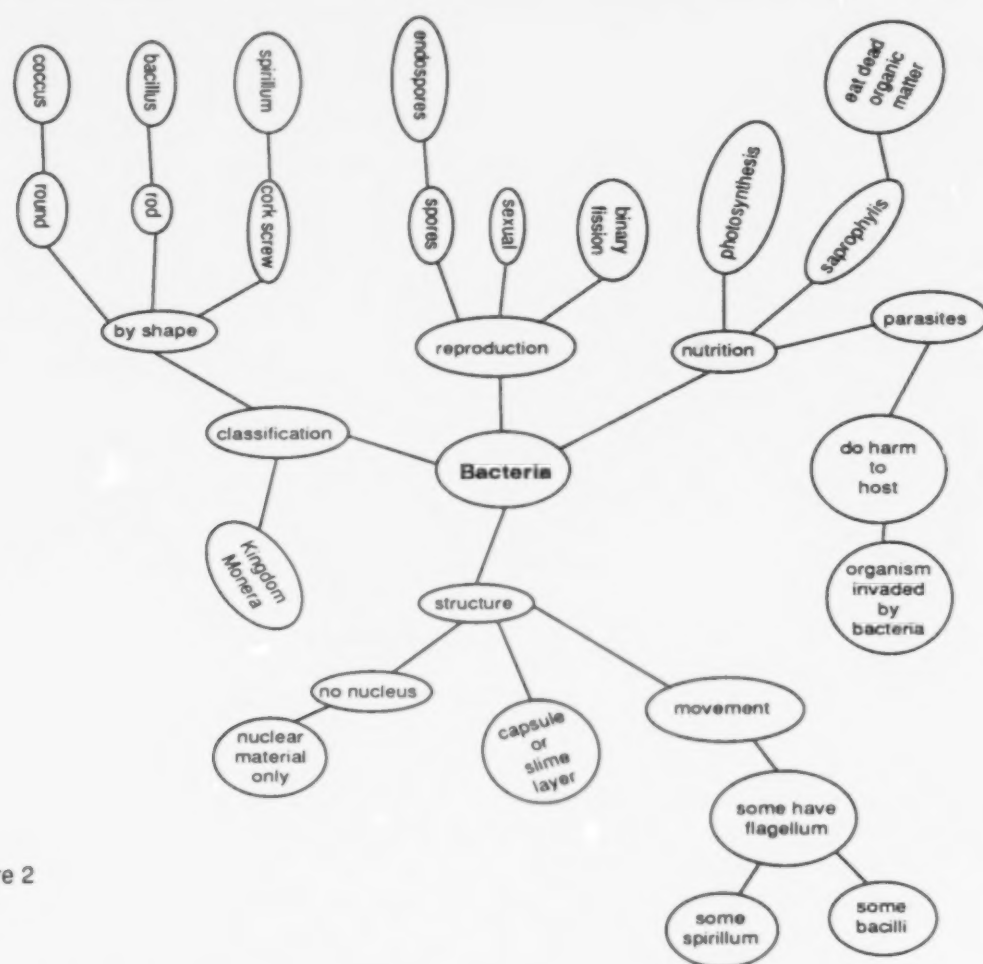


Figure 2

During class on the third day, the students write their first drafts of their papers. They may use only their bubble notes for reference. The purpose of these papers is to put down ideas, not to worry about grammar, punctuation, spelling, or form. When these papers are completed, the students are grouped into pairs and read their papers to their partners. At this time, the group should correct form and grammar.

Students then take the first draft home. I ask students to read their papers to their parents and to make any corrections necessary. After using a dictionary to correct spelling and to rectify any

punctuation or grammatical errors, the students write their second draft.

The next step is to ask a parent, older sister, brother, or friend to read the paper orally while the students listen for fluency. Again, the student should make revisions.

On the fourth day, I collect all three papers. The second draft should be on top, followed by the first draft, and then the library research notes. I accept only those packets which are complete and in order. Then I read and grade this stapled packet for content only.

It is important to check to see if the students are writing about their topics,

if they have the correct number of paragraphs, and if they are generally on task. A stamp that prints "READ FOR CONTENT ONLY" is convenient.

A time lapse is important to allow students to see their papers from a different perspective.

When the papers are returned, the students exchange papers and read their partners' papers to them. Red pencils are available for students to make corrections. Most students are surprised at the number of errors they find.

After this final check for grammar, punctuation, spelling, and fluency, the students are ready to write their final drafts. At this time, it is important to express the significance of a well-writ-

ten paper, emphasizing neatness, use of ink and only using one side of the paper. When the period is over, I collect the papers.

Students who do not finish, must come in before school to complete their papers. The student paper-clips the final draft and bibliography to the top of the stapled packet containing the second draft, first draft, and the library research notes.

The main objective of this method is to place responsibility on the students and to make them realize they can write. This process also relieves the teacher workload (in terms of correcting papers) and encourages student originality. ♡

Writing for Science Concepts in the Third Grade

Joni Cooper-Meredith

Hidden Valley Elementary School
Reno, Nevada

I teach third grade and have many children working at different academic levels. Questions at the end of a chapter and the tests the text provides are extremely intimidating not only to my slower children, but even to the brighter ones. Writing in a science classroom should not be limited to writing the answers to the questions at the end of a chapter, but should include writing that is more creative and sparks an interest in the children.

So far this year when I ask the children to bring out their science books they are excited and eager. I want to keep this attitude going, so I am trying many of the ideas from Bob Tierney's workshop.

Another lesson I taught with great success was about rocks. After reading the chapters in our textbook about rocks and their properties, I asked the children to find a rock of their own for a pet. They were told that they could paint it, color it, add things to it, and that they had to name it.

After they brought these in, they were told to write a story about their pet rock, incorporating some of the rock's properties into the story. Their rocks could do anything they wanted them to. After students wrote the stories, which I did not look at or correct, I asked each student to read his/her story to the class. Some of the things they came up with were outrageous.



One little girl had made an antenna out of foil with glitter all over it and decided to make her "pet" a rock from outer space. Another child made his into a punk rocker. The stories were great, and the children loved listening to each other's imaginative creations.

Writing in science has given me so much incentive to teach in a different way and to go beyond just using the text. I'm sure my enthusiasm for it is wearing off on the children, too. ☺

Teaching the Atom: My Philosophy

Jeannie Steinman

Winnemucca Junior High School
Winnemucca, Nevada

The first time I taught a unit on the atom, I was student teaching the ninth grade. When I announced to the class that our first unit would be on the amazing atom, they responded by groaning in unison. They informed me that they had been taught about the atom in the past, they didn't understand it then, they wouldn't understand it now, and perhaps we should go on to the unit on volcanoes.

As tempting as their suggestion was, I said no, gritted my teeth and began to formulate a plan. I realized that if I were to be successful at student teaching, the students were going to have to feel they were successful at learning the material in this first unit.

I proceeded to break the unit into small, nonthreatening blocks of information that could be built, one on top of the other, into the concepts of the atom. Once the students realized how simple the atom was, they gained confidence. Some students began to see that they could understand other concepts that were difficult for them if they broke the information down into small enough blocks.

Since that time, I have tried to make my class success-oriented. I do not try to over-simplify. I try to present information in small doses, reinforce it, review it, then move on to the next step. I try to keep the students' attention by varying my method of presentation. Then after the students have learned the basic facts using the building-block method, the next step is to try to get the students to use their knowledge, to attempt to analyze information and draw their own conclusions - something they should now be equipped to do since they have mastered the basic concepts

of the subject taught.

Overall, I hope to remove some of the threat that many students seem to feel toward science and instill in them an appreciation of a logical step-by-step approach to problem-solving and learning.

Lesson Plan - The Atom (Sixth grade)

Previous Activities: What is Matter?; Forms of Matter (solid, liquid, gas); Particles in Matter; Phases of Matter (mixture, compound, element); Periodic Table.

Objectives: The student will be able to:

- 1) Identify the parts of the atom (nucleus, protons, neutrons, electrons.)
- 2) Know and be able to draw the location of protons, neutrons and electrons.
- 3) Know charges of protons, neutrons and electrons.
- 4) Tell how many protons, neutrons and electrons are in a particular atom, given the atomic number and atomic mass.
- 5) Know that an atom has a neutral charge.

Day 1:

Lecture (5-10 minutes)

- 1) Particles that make up matter are called atoms.
- 2) Parts of the atom.
- 3) Location of subatomic particles

Activity

Numerous construction paper circles are laid out on each table - yellow circles marked "e", blue circles marked "n", pink circles marked "p". Teacher explains the symbols, then tells how many protons, neutrons and electrons an atom has. The students arrange their circles into a model of the atom. The teacher checks the atoms.

Do this with a few different atoms.

Students now do individual worksheets where they draw and label a specified atom.

Homework

Students go home and tell their parents they are learning about subatomic particles.

Oral Review

Lecture (5 minutes)

- 1) Charges of protons, neutrons, electrons
- 2) Atom has no charge

Questioning

- 1) How can we make sure that an atom has no charge? -Guide students toward the number of protons equalling the number of electrons if they are floundering, perhaps by putting the equation $(-1) + 1$ on the blackboard and asking the students what it equals.
- 2) Give several examples of "if an atom-like particle has ___ protons and ___ electrons, is it an atom? Why? Why not?"
- 3) Do neutrons affect the charge? Why or why not?
- 4) Does the number of neutrons have to equal the number of protons and electrons? Why or why not?

Summary

Have students summarize what they have learned about the atom brainstorm style.

Assignment

The students are to write a brief story, myth style, as to why the subatomic particles are arranged as they are and/or why they have their particular charges.

Day 3:

Share stories on a voluntary basis

Lecture

- 1) Review periodic table; point out atomic number and atomic mass.
- 2) Atomic number equals the number of electrons equals the number of protons.
- 3) Number of neutrons equals atomic mass minus atomic number.

Assignment

Worksheet with atomic numbers and atomic masses of various elements. These are used to calculate the number of protons, neutrons and electrons. Do several

as a class, then finish individually. Correct in class.

Day 4

Review

Activity

Students make construction paper models of atoms. Each group is given an atomic number and atomic mass. The students calculate the number of protons, neutrons and electrons, and after these numbers are checked by the teacher, they make their model. Each group discusses their model briefly after construction.

Homework

Each group of students is to bring toothpicks and suitable candy to construct a three-dimensional model of an atom.

Day 5:

Activity - Can also serve as an evaluation. Each student group chooses an element with an atomic number greater than five, but less than fifteen. The students calculate the number of protons, neutrons and electrons, then make a three-dimensional model of the atom using toothpicks and candy such as gumdrops. The model is displayed with a key identifying the element, the atomic number, the atomic mass, the colors of the various particles, the number of each type of particle, and the charges of the particles.

This unit on the atom may take longer, depending on the level of the students. From this point, I move on to ions and then to molecules.

The Results

The fundamental lessons on the atom can be difficult because there are no earthquakes or explosions to really grab the students' attention. It is hard for some students to accept the fact that something exists that cannot be seen with a microscope. They need and want hands-on experience and the best I can do with the atom is modeling. Fortunately, most students seem to enjoy modeling, so I've made it a major part of this unit. The candy models are,

of course, the favorite. I've found it wise not to mention the candy models until after the students make their paper models so as not to decrease the amount of effort the students put into their plain old paper models.

The three times I've done candy models with my classes, the results have been excellent and the students have been very good about not purloining candy from the models on display. The students get to eat their models immediately after the written atom test. I try to give that test the day following the model-making, particularly if any students have used marshmallows.

The biggest surprise to me in this unit was how popular the myth writing done on Day 2 was. One group even performed an atom play for the class. My students seem to see writing in two lights - "writing" writing, or, how long does it have to be?, and creative writing, which is fun.

The students seem to feel less pressure in creative writing and they seem to feel more successful. They are aware that as long as they put forth a suitable amount of effort, whatever they produce will be accepted. It is an artistic endeavor with no facts to be marked right or wrong.

Since figuring this out — which unfortunately was halfway through this last school year — I've tried to blend a little creative writing with science writing. Science myth writing is one way to do this since the basic facts must be correct by the end of the story, but the writing isn't as threatening or boring because the students are allowed to give rein to their creativity. I asked the students how they felt about this assignment and they agreed almost unanimously that it helped — a lot. I think one reason for this is that it helps the students master the basic facts because they actually have to use them.

It also allows each student to create his or her own mental image of the atom.

I've included three student myths at the end of this article and I find they create rather interesting mental pictures.

This year I corrected the misinformation in the myths myself, but next year I plan on having the student groups find the misinformation by checking each other's stories before they are handed in. If I find an error, I'll return the story to the group for correction.

After teaching this unit, I felt that the majority of students came away with the basic concepts of the atom, but just to check, I gave a post-unit evaluation which the students filled out anonymously. I received sixty responses.

Of those sixty, fifty said they understood the lessons and forty-three said they wouldn't mind studying the atom again. The remaining seven found the subject boring, but felt they understood it. One student saw no reason to study the atom again because "we already know it." I hope I'm not responsible for a rude awakening later in that student's scholastic life. It has occurred to me that some of the ten students who said they did not understand the lessons may be ESL students and I may need to work more closely with the ESL teacher next year.

I received several comments on the evaluations, most of which were positive. A number of students commented on the fact that I explained everything thoroughly.

One student said that he (or she) didn't want to learn about the atom at first "because I find it hard to understand," but that he understood it this year because "you explain it very well." I received comments on going slow and making everything clear, but my favorite comment of all was a brief "I understood everything she said." I rather like that. I'm going to try to do it again next year. ☛